Quantifying Hydrologic "Flashiness"

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Biographical Sketches of Authors

R. Peter Richards is a Senior Research Scientist at the Water Quality Lab, where he has worked for the past 25 years. Pete's expertise lies in the use of data analysis and statistics to turn masses of data into useful information. He has worked extensively in the areas of pollutant load estimation, detection of trends in chemical constituents, and design of sampling programs for chemical constituents in rivers and streams.

David B. Baker is Director Emeritus of the Water Quality Laboratory. He remains active in a variety of water quality research, monitoring, and management activities. These include topics of natural streamflow restoration in agricultural watersheds, development of comprehensive management plans for addressing TMDL issues in agricultural watersheds, and stakeholder education related to the above topics.

Tim Loftus, director of the Water Quality Laboratory, is an environmental geographer with interests in watershed management, landscape ecology, riparian ecosystems, and environmental policy. As chairman of the Sandusky River Watershed Coalition, Dr. Loftus is currently working to integrate research with development and implementation of watershed action plans that aim to satisfy TMDL requirements for improving water quality at the spatial scale of HUC-11 watersheds.

Abstract

The frequency and rate of change in a stream's flow in response to precipitation is an important element of the flow regime of the stream. This pattern of response is revealed by the stream's hydrograph, and is often described using the term "flashiness", though this term is rarely explicitly defined. Departures from natural flashiness impair aquatic ecosystems, regardless of whether the departures involve decreased or increased flashiness. Departures from the natural flow regime can be caused by many factors, including flow regulation and other forms of hydromodification, land use change, agricultural drainage practices, urbanization, land management practices, and climate change. Changes due to impoundment happen quickly at a known time, but changes due to most aspects of land use and climate change happen incrementally, and may not be evident without a suitable metric to characterize flashiness. We have developed a new flashiness index based on mean daily flows measured at U.S. Geological Survey stream gages. This index shows relatively small inter-annual variability, making it efficient for trend detection. The index was applied to 515 gages in the Midwestern U.S. (1975-2001). Results show strong regional differences in flashiness, and many statistically significant temporal trends. This new index should prove useful for monitoring watersheds for changes in hydrologic regime in response to climate and land use changes, and for summarizing differences between current hydrology and pre-settlement hydrology as determined by land-use/hydrologic-response models.